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AMERICAN
STATISTICAL ASSOCIATION

NEW SERIES, No. 113. MARCH, 1916.

THE NATURE AND SIGNIFICANCE OF THE CHANGES IN THE BIRTH AND DEATH RATES IN RECENT YEARS.*

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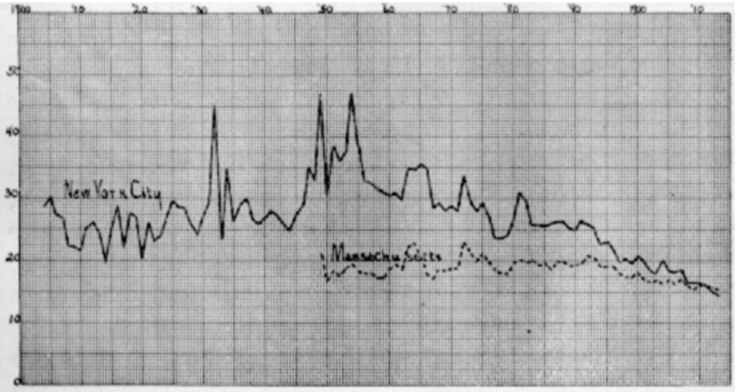
Certain important changes in death rates are revealed by a diagram showing annual death rates for a populous area through a long series of years. The American districts best satisfying these two conditions are Massachusetts, for which the death rate since 1849 is known, and the old New York City, for which the death rates run back now through more than a century.

The accompanying diagram shows the death rate in each of these areas for each year from the beginning of registration to the present date.

Death Rates-New York City, 1804-1913; Massachusetts, 1849-1913



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* Paper presented at the joint meeting of Section VIII of the Second Pan-American Scientific Congress and the American Statistical Association, Washington, D. C., December 30, 1915.

This diagram illustrates what a larger body of evidence would confirm, that the perceptible and steady decline in the death rate is a relatively recent phenomenon. In order to test the correctness of this inference, the average death rate has been computed for each decade and the ratio found between that rate and the rate in the preceding ten years taken as 100. The results are as follows:

Date.	Death Rate in		Ratio of Rate to that in Preceding Decade = 100.	
	New York City.	Massachusetts.	New York City.	Massachusetts.
1804–09	26.3	....	....	....
1810–19	24.7	....	94.2	....
1820–29	25.8	....	104.2	....
1830–39	29.8	....	115.7	....
1840–49	30.3	....	101.5	....
1850–59	35.6	18.0	117.7	....
1860–69	31.7	19.4	89.0	107.8
1870–79	27.6	19.7	87.2	101.6
1880–89	26.8	18.6	97.1	99.6
1890–99	23.1	19.1	86.0	97.1
1900–09	19.0	16.0	82.3	84.0
1910–13	15.3	15.5	80.6	96.7

These figures show that the decennial death rate in New York City rose for the forty years following 1810–19, but has been falling since the Civil War and is now much lower than ever before. In Massachusetts the rate rose until about 1880 and has been falling since that date, but at a slower rate than in New York. Decennial rates for at least two decades have been obtained in twenty-seven European countries and in every one the rate for 1901–10 was lower than for any previous decade. This evidence shows that the decrease of the rate is well-nigh universal in Europe. A few exceptions to the rule, however, are found in other parts of the world; namely, Ontario, Canada, Connecticut, Michigan, Vermont, Chile, Jamaica, Japan, and Ceylon. But in some of these the rates at earlier decades were incredibly low and the apparent increase was probably due, in part at least, to more complete returns of deaths in the later years.

The diagram also suggests that the annual fluctuations began to decrease at about the same time that the rates began to fall. To judge whether this is a general or only a local change, conditions in the twenty-three countries of Europe* for which the rates as far back as 1870 are known have been examined. The average annual variation has been determined. Naturally the successive years between which the greatest variation occurred were the years of transition from peace to war or *vice versa.* Thus, the greatest changes occurred between 1871 and 1872 and between 1870 and 1871. The war of 1876 exerted a less noteworthy influence. On the whole, the annual fluctuations have decreased but the change is less obvious and uninterrupted than students of individual cities or countries might expect.

Both the steady decrease in the death rate and the slow reduction in the annual fluctuations mark and measure man's progressive emancipation from physical ills of disease or famine, which are closely dependent upon climate and season, and we might have thought, before August, 1914, from the political ills of war and revolution.

In New York State between 1894 and 1909 there was a marked decrease in mortality during July and August as compared with the average for the entire year. I believe no similar studies have been made for other states. In default of other evidence we may conclude that one factor in the diminishing death rate has been an increased control of deaths in summer. If this should prove to be a general fact, it would probably be connected with the success of efforts to reduce infant mortality. The hot months are especially dangerous to infants, while the cold months are especially dangerous to the aged.

Age influences the death rate more powerfully than any other physiological factor. Most people know that the death rate is lowest at the age of puberty and very much higher at the beginning and end of life. But the amount of difference is not commonly realized. In New York State boy babies under one year of age suffer from a death rate 65 times that of boys of 10 to 14. The death rate of nonagenarians rises to 159 times that of the youth.

It would be a natural expectation of one who is told that the death rate is rapidly falling that the gains had been distributed somewhat evenly up and down the scale of years. But this anticipation is not borne out by the facts. Even in a hurried survey like this, two points, the possible increase of infant mortality and the possible increase of mortality among the aged, call for mention.

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* For this purpose the three divisions of Great Britain and Ireland and the eight divisions of the German Empire have been treated as countries.

High medical authority in England alleged nearly ten years ago that infant mortality is stationary or increasing and this conclusion won some acceptance in the United States. Fortunately the figures proved to be susceptible of another explanation. But into that question there is now no need to go, since even in England and on the face of the figures infant mortality has decreased since 1900. Indeed among the nineteen countries of Europe for which statistics are at hand there is not one in which infant mortality has shown no decrease since the beginning of the twentieth century. In the United States the registration of births is still very defective and there are no large population groups for which we know the true infant mortality, that is, the number of children dying in the first year of life to each thousand living births. Our best substitute for this figure is the ratio between the deaths under one year of age and the living children under one. In the registration states of 1900, comprising 26.3 per cent. of the country's population, this ratio fell from 162.4 per 1,000 in 1900 to 141.7 in 1910, indicating that infant mortality fell about one eighth in the decade.

When we turn to the other end of life, the indications of our American figures are less gratifying. In the registration states of 1900 the death rate decreased between 1900 and 1910 for every age period below 55 and increased at nearly every age period above 55. On this point our experience is apparently at variance with that of Europe. The latter indicates that before 1900 the fall in the death rate as a rule extended to all ages and was especially great at ages between 5 and 53, but that for ages above 55 it was slight or in some countries absent.* The English life tables published in 1915 and speaking for a more recent period show that at every age above 5 years the mortality in 1901–10 was less than that in 1891–

* March, Statistique intern. du Mouvement de la Population, Vol. I, pp. 431–439 and 450.

1900 and that the mortality in 1910–12 was less than that in 1901–10.*

The apparent increase of mortality at high ages in our registration states, in opposition to the general trend in other countries, invites and should be given more careful and thorough analysis than it has thus far received or than I have been able to give it for this paper. Although it appears in both sexes, it does not show itself among women until the age of 60 is reached, while among men over 45 the death rate in 1910 exceeded that in 1900. It appears also among the three classes of native white, foreign born white, and colored, earliest among the colored with whom the increase appears in each sex at every age above 30, latest among the foreign born whites with whom the increase does not appear in either sex until the age of 60 and then for females appears only for the ten year age period 60–69. It appears in a prevailingly agricultural state like Vermont at an earlier age and more definitely than it does in a prevailingly industrial state like Massachusetts or Rhode Island. In a recent reference to this change, based mainly upon the figures for Massachusetts and New Jersey between 1880 and 1910, three possible causes were mentioned, "the amalgamation of the various races that constitute our population," "lack of adaptation to our rapidly developing civilization," and "some unknown biologic influence," and a preference for the second was indicated.† Thus far no evidence has been produced, I believe, showing that the increase is greatest where amalgamation of races is probably affecting the largest proportion of the population or where the lack of adaptation to a developing civilization is greatest.

An influence upon mortality which the United States is in a more favorable position to investigate is that of *race*. Under this term I do not include those residents in the United States who or whose progenitors were born in a certain country or spoke a certain language, like the Scandinavians or the French Canadians. At some future time we may be able to investigate the death rate of groups like those, although the present position and sluggish development of American vital statistics make one fear that the facts may become inaccessible before the country is ready to study them. I refer here to the two great races of white and Negro, which include between them more than 99 per cent. of our population. The registration states of 1900 contained in that year 19,544,821 whites and 388,198 Negroes and many more in 1910, groups large enough and residing in states widely enough scattered to make the changes in their death rates between 1900 and 1910 somewhat representative of the changes in the whole country.

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* Reg. Gen., Supplement to 75th Ann. Rep., Pt. I, Life Tables, p. 20.

† Fisher and Fisk, How to Live, p. 282. See also Lewinski-Corwin in New York Times, Magazine Supplement, Dec. 19, 1915.

The death rate of whites in these states fell from 17.0 in 1900 to 15.5 in 1910, a decrease of 1.5 per 1,000, or 8.8 per cent. of the initial rate. Meantime the death rate of Negroes in the same states fell from 25.6 in 1900 to 25.0 in 1910, a decrease of 0.6 per 1,000, or 2.3 per cent. These figures show that the fall in the death rate during the decade was more than twice as great among whites as among Negroes. Stating the same change in another way, the death rate among Negroes in these states exceeded that among whites by 51 per cent. in 1900 and 61 per cent. in 1910.

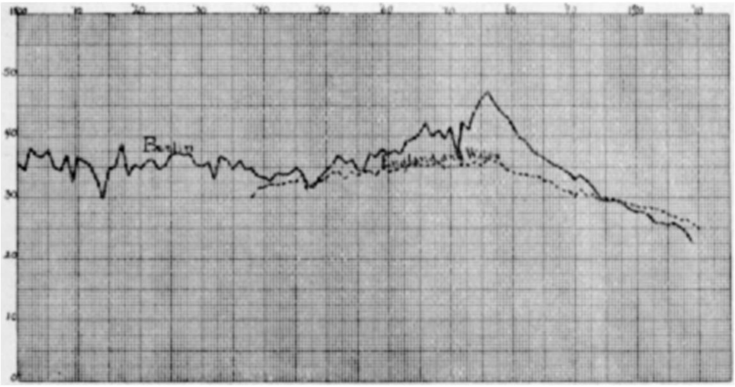
But to compare the two races in this way and stop without noting whether significant differences exist between the age and sex composition of the two groups might easily lead us into error. Thus among the whites 50.5 per cent., but among the Negroes only 48.3 per cent. were male. As the female death rate is regularly lower than the male, the true difference between the death rate of the races would probably be greater than the foregoing figures indicate. Even more important is the fact that of the whites 21.5 per cent., but of the Negroes only 16.1 per cent. are either children under 5 or aged 55+ and have the high death rate characteristic of infancy and old age.

Probably the best way to measure the effect of these differences in sex and age composition is to compute standardized death rates for each race. When the death rates of each race for a given sex and age are applied to the population of the same sex and age in a standard million distributed as in the registration states of 1900, the standardized death rate in 1910 is found to be 15.5 for whites and 27.5 for Negroes, showing that the corrected death rate of Negroes exceeds that of whites by 12.0 per 1,000, or 77 per cent. The corresponding standardized death rates in 1900 were 16.9 for whites and 29.0 for Negroes, showing a fall during the decade of 1.4 per 1,000 for whites and 1.5 per 1,000 for Negroes. But in 1900 the standardized Negro death rate exceeded that of the whites by 72 per cent. as compared with 77 per cent. in 1910. The standardized death rate among female Negroes exceeds that among female whites by 61 per cent. in 1900 and by 72 per cent. in 1910, while the difference among males was 69 per cent. in 1900 and 84 per cent. in 1910, showing that the difference between the males of the two races is greater and increasing more rapidly than among the females. The death rate of each race is falling, but the gap separating the two races has seemingly grown wider. Before the Civil War, according to what evidence we have, the death rate of Negroes exceeded that of whites by 29.8 per cent. of the lower rate, and in 1890 the difference was 56.5 per cent. These earlier rates are not strictly comparable with each other or with those for 1900 and 1910, partly because they speak for different areas, neither of which agrees with the registration states of 1900, and partly because in them no attempt has been made to allow for differences in the age and sex composition of the two races or for changes in these respects. The general conclusions, however, that the death rate of each race has fallen by approximately the same amount and that the ratio by which the Negro rate exceeds the white has been rising, seem to be supported by evidence enough to make them deserve acceptance.

Still another influence upon mortality which has been recently investigated is that of *marital condition.* European figures indicated long ago that the mortality of husbands is much less than that of bachelors or widowers of the same age and the conclusion is now corroborated by figures for New York State. No doubt this difference is largely due to the selective process by which the men who marry are, on the average, at the time of marriage more healthy and vigorous than men of the same age who do not marry. Evidence that direct benefits to health accrue from married life is found in the death rate of widowers, which is much higher than that of husbands, in the death rate of Catholic celibate clergy, which is higher than that of Protestant clergy, most of whom are married, and in the death rate of all males during the years at which marriage is most common. The normal and usual course of mortality in each sex is for a slow but steady increase to begin just after the minimum is reached in the early teens, and to continue with accelerating rapidity to the end of life. To this course there is no significant exception among women, but among men in several countries the increase is checked or even turned into a slight decrease for a longer or shorter period between the ages of 20 and 35 when marriage is most common. The probable explanation is that the normal increase of mortality during these years is nearly or quite neutralized by the steady transfer of many men from the less healthy bachelor state to the more healthy married state. The explanation finds some support in the fact that during these years the death rate of bachelors treated separately rises steadily with age. On the whole, the evidence justifies the inference that marriage exerts a directly beneficial influence on men's health and prospects of longevity. For wives the facts are less favorable. In New York the death rate of wives between 20 and 29 is greater than that of single women at the same age period. The difference is slight and part of it no doubt is due to the fact that wives 20 to 29 years of age are, on the average, more than two years older than spinsters belonging to the same age group. But as less than half the difference can be thus explained, it seems clear that in New York, as in most other areas in which the facts have been determined, during the early years of married life wives have a higher death rate than spinsters and probable that the difference is largely due to the dangers attending childbirth, especially among primiparae. But though the mortality of wives 20–29 years old is greater than that of spinsters or husbands it is less than that of bachelors.

There are no American *birth rates* which extend over a long series of years and may be trusted as accurate. In default of evidence from this country I have used in the diagram the birth rates for England and Wales since 1838 and for Berlin since the beginning of the last century. The diagram shows that the birth rate was probably at its maximum about 1875 and has decreased almost steadily since that date, that the decrease in England has been about one third and in Berlin about one half of the maximum amount, that the variations both from year to year and through longer periods were greater in the city than in the entire state, that the decrease since 1876 has been almost uninterrupted, that there was a marked depression in both areas in 1890, and that Berlin had a much more notable depression in 1871. If in the other diagram we had used the death rates for Berlin, high points on that curve would have been revealed in 1871 and 1890 when the birth rates were low.

Birth Rates-Berlin 1800 to [illegible]



As a rule influences which tend to increase deaths tend also to decrease births, and influences which tend to decrease deaths tend to increase births. This appears even in the rhythm of each day, Italian figures apparently showing that deaths are most frequent and births least frequent in the afternoon. There is also a yearly as well as a daily rhythm traceable in the figures but in this case the reciprocal relationship is between conceptions as mirrored in the births nine months later and deaths. There is some evidence that during the late spring and early summer and again during the late fall the death rate is low and the conception rate high. There is some evidence, likewise, that during the late winter and the late summer the death rate is high and the conception rate low.

This reciprocal relationship between births or conceptions and deaths appears also in the case of any great social calamity. As a war or a pestilence raises the death rate, so likewise it depresses the birth rate, and in estimating the social effect of either it is of the first importance to consider not only the deaths it has caused but also the births it has prevented. For example, in Massachusetts between 1860 and 1864 the death rate rose from 18.7 to 22.8, an increase of 4.1 per 1,000, and the birth rate fell from 29.3 to 24.2, a decrease of 5.1 per 1,000. In Sweden continuous and trustworthy records of births and deaths have been maintained without a break since 1749, a longer period than in any other country. The year 1773 was marked by the heaviest death rate of this century and two thirds and during that year the birth rate was also lower than in any year before or since. The most universal and fatal epidemic which has afflicted civilized countries of recent years was probably the first of the recent visitations of influenza, which spread over Europe and America in the winter of 1889–90 and caused in New York State about 5,000 deaths. Wherever the births were reported and published by months one finds, nine months after the influenza epidemic was at its height, a marked shortage of births. There were at least 200,000 fewer births in Europe in 1890 than the average annual number for the preceding five year period.

Now the most marked change in the birth rate during the last half century, a change revealed by a comparison of the two diagrams, has been the gradual decline and almost complete disappearance of this reciprocal relationship between births and deaths and the appearance in its place of a tendency for births and deaths to change in the same way rather than in opposite ways. Before proceeding to consider the causes, let me set forth the facts a little more fully.

1. The birth rate and death rate now remain approximately the same in any given country during any few years. The sharp annual variations which characterized these rates and which are still traceable in the statistics of undeveloped countries are disappearing.

2. The tendency of both death rates and birth rates is to undergo large and important modifications in longer

periods of time. The sharp up or down movements in both curves connected with such causes as war, pestilence, or famine, on the one hand, or bountiful harvests and cheap food, on the other, are being succeeded by a steady progressive downward movement in the death rate and the birth rate.

Regarding the birth rate in the United States we know practically nothing. But in default of this information I have found an available substitute by comparing the number of children under 5 years of age at the date of each census with the number of women 16–44 years of age at the same census. The results are given in the following table, in which the figures before 1850 are estimated from such data regarding sex and age as the earlier censuses afford.

Date.	Number of Children Under 5 Years of Age to 1,000 Women 16–44 * Years of Age.
1800	976
1810	976
1820	928
1830	877
1840	835
1850	699
1860	714
1870	649
1880	635
1890	554
1900	541
1910	508

During the sixty years 1850–1910 the number of children to 1,000 women of child-bearing age decreased in the United States by 191, or an average of 32 in each decade. There are only about seven tenths as large a proportion of children in the United States now as there were in 1850. If we assume that the change will continue in the direction in which it has been moving ever since 1860 and at this average rate of 32 in a decade, the number of children under 5 in the country to each 1,000 women 16–44 will be as follows:

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* In order to reduce the error of the estimates in the earlier decades to a minimum, ages 16–44 were chosen instead of 15–49, the more usual limits.

1920	476
1930	444
1940	412
1950	380
2000	220
2050	60
2060	28
2070	0

The figures indicate that, if changes like those which have been in progress in the United States since 1850 should continue unchecked for a century and a half, there would be no children left. Let me not be understood as predicting a continuance of the movement for any long period in the future. But often the best method of bringing home to ourselves the vast sweep and significance of the changes revealed by statistics is to project them into the future and see whither they lead. No doubt social movements do not occur along straight lines. On the contrary sharp inflections in the curves of social change are frequent. But it is one of the main duties of statistics to point out the trend of the stream along which society is moving and thus perhaps to arouse a desire for a change.

This tendency to a decline in the birth rate is in nowise confined to the United States. On the contrary the movement in most European countries has been in the same direction. In twenty-four European countries, all, except Ireland, Portugal, and Bulgaria, for which the records are at hand, the birth rate 1901–10 was lower than in the preceding decade and in nearly all of them it was lower than in any earlier decade.

In considering the causes of this great change, let me refer first to the position of Herbert Spencer. He has argued that the various organs of the body compete with each other for nourishment and growth, that the surplus not required by the individual is all that can be devoted to the continuance of the race, that no other system makes demands upon the body as heavy as those of the nervous system, that civilization and education are steadily increasing this drain and decreasing the surplus. He finds, therefore, a natural and inevitable connection of a physiological kind between an advancing civilization and a decreasing birth rate. Some students of American statistics have sought to find support for this position in our fragmentary and elusive material. I cannot go farther with the question this morning than to express my judgment that these efforts have not been successful and that there is no conclusive evidence, statistical or otherwise, in support of Spencer's contention. While admitting the heavy and increasing demands upon the nervous system made by modern conditions, I would point out that the decreased death rate and the decrease of sickness by which it is probably attended mean an increase of human vitality and so of the surplus to be drawn upon. Whether the increased expenditure on the nervous system equals or exceeds this increased surplus no one has even tried to prove. Until that is done I believe the Spencerian theory must be deemed only a theory.

Nor can we admit, as others have argued, that the decreased birth rate in civilized countries is due either to the growing abuse of alcohol or to the spread of venereal disease. Such arguments have come mainly from special students of these social evils and such students often lose the sense of proportion and find a relief from every social ill in the one reform on which their eyes are riveted.

Walker explained the decrease in the American birth rate by the menace to the American standard of life from the influx of swarms of immigrants accustomed to cheap food and clothing and bad housing and to the effect of this menace upon the birth rate primarily of the native stock and ultimately of the entire population. This explanation is improbable, because the decrease as we have seen began as early as 1810, when immigration was an unimportant influence, and has been matched in Australia, where it must be due to other causes than that assigned by Walker, since Australia has had no great influx of immigrants.

Turning from these inadequate explanations, the true reason for the fall in the birth rate is that in modern times, mainly within the last half century, births and the birth rate have come under the control of human will and choice in a sense and to a degree never before true. Our leading American authority, Dr. John Shaw Billings, put it as follows: "The most important factor in the change is the deliberate and voluntary avoidance or prevention of child-bearing on the part of a steadily increasing number of married people who prefer to have but few children." Before this change began the birth of a child was, to be sure, the result of normal physiological processes, but in the vast majority of cases the birth itself did not indicate a deliberate preference for that result on the part of both or either of the parents. There is not a single one among the experts who denies that this is the great underlying cause of the modern decline in the birth rate of all civilized countries.

In considering this change may I first suggest that some such change was an almost necessary consequence of the great decline in the death rate? That is, if the death rate in Europe had declined as rapidly as it has and the birth rate had not declined, the population of that continent would now be increasing even faster than the wealth or the food supply. The standard of living would be sinking and we would probably soon relapse into our former ill state. It is the decline in the birth rate, and only that, which has enabled mankind to grip and hold fast the advantages promised by the decline in the death rate.

But there is a very important difference between the two changes. It is probably to the interest of society in the long run that each individual should be given a chance to live out his life to old age, and social effort directed to that end is beneficial both to the individual and to society. Thus far the interests of the two coincide. For this reason the two have coöperated and are coöperating effectively to reduce the death rate. But in the matter of the birth rate there is a lack of adjustment between the interests of society and those of the individual. Society is deeply concerned that enough children should be born to secure its own permanence and a reasonable increase and that those children should have the highest promise of service. The individual is deeply concerned not to compromise his own future by assuming responsibility for wife or family without the prospect of being able to maintain them in accordance with his standard of living. The individual may often see for himself or herself, therefore, a balance of advantage in abstinence from or postponement of marriage, in a childless marriage or a small family, while society from its point of view might conceive it to be most important that a given endowment of much social worth should be perpetuated.

If there were time it would be easy to show that a low and diminishing birth rate is especially characteristic of many strains of population, like college graduates of both sexes and the native American stock of the New England states, stocks perhaps better endowed than the average population with hereditary qualities the perpetuation of which is socially desirable.

While persons engaged in grappling with public health problems should interest themselves in the various changes I have briefly outlined, the main question which my figures raise is this: How shall the desirable natural increase of the population be secured and at the same time the quality of the population be maintained or improved by securing at least a normal or average and, if possible, a more than normal birth rate and natural increase in the strains of population which are of the best stock and therefore likely to transmit qualities of greatest social worth?

In this difficult field a few general principles may be stated dogmatically, which I would be glad to explain and defend, if there were time.

1. The death rate cannot be expected to fall much below where it now stands in healthy districts.
2. There is no such natural limit to a fall in the birth rate.
3. The spread in the volitional control of the birth rate is a change against which, even if we believe it undesirable, it is hopeless to struggle.
4. Legal regulations of marriage in the effort to diminish the number of births of diseased or otherwise undesirable children seem likely, unless accompanied by segregation, to do more harm than good.
5. The social service rendered by parents who have hereditary qualities of great value and make heavy sacrifices in other directions in order to rear families of normal size or larger is likely in future to be much better appreciated and requited.
6. Persons interested in maintaining the numbers and improving the quality of the population should aim not merely or mainly at a continued reduction of the general death rate but also at the gradual education of public opinion towards a readjustment of the birth rate in various classes which will enable society to gain from its best strains more than it can do under present conditions.